Sumac

ITS COLLECTION AND CULTURE AS A SOURCE OF TANNIN

By JOHN E. BEAR
and A. F. SIEVERS

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ITS COLLECTION AND CULTURE AS A SOURCE OF TANNIN

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Sumac, known to the public in the United States chiefly as a vigorous beautifier of roadsides and wastelands, contains much tannin in its leaves and leaf stems. Tannin extracted from the leafage of this shrub or small tree is regularly used by tanners in this country in producing certain types of leather. For almost a century several of our native sumac species have been recognized as a plentiful source of this substance essential to the tanning and dyeing industries. Nevertheless United States industries, thus far, have used only very small quantities of native sumac material as a source of tannin; they get the sumac tannin they need mainly by importing, from Sicily, leaf material of the sumac species *Rhus coriaria*. The Sicilian product has a greater tannin content, is more uniform in quality, and hence generally gives better results than sumac leaf material collected and marketed in this country. Its superiority is due not so much to higher natural quality as to greater care in preparing the product for market.

Interest in our native sumacs as a source of tannin has increased from time to time as domestic supplies of the vegetable tanning materials commonly used in the United States have gradually declined. Improvement in the quality of the domestic harvested product would certainly increase the demand for it. Sumac can flourish under a great variety of environmental conditions, and it grows naturally in almost all parts of the eastern half of the United States. Efforts to grow the commercially used native species as a farm crop have sometimes been suggested, particularly when the supply of American chestnut wood was beginning to dwindle as a result of the chestnut blight epidemic and when world conditions have threatened to interfere with importing tanning material from other countries. For these reasons, the Agricultural Research Service has made a study of the propagation and management of sumac as a crop to be grown on farms in order to supplement income from principal crops. The study dealt with the native species that have been utilized to some extent in this country for tannin production. This report discusses the utilization of wild sumac for tannin production in the United States and presents the results of the study of sumac as a cultivated crop.

Throughout the many years of limited utilization of native sumacs, collection of sumac leaves has been for the most part an activity of owners and tenants of small farms and members of their families. It has been carried on in several localities in Virginia and a few in Maryland and West Virginia. Possibly some communities in other South Atlantic States have

taken part. Collection has centered principally in a few localities where buyers of the product are established year after year. The quantities gathered and sold have varied from year to year according to the extent to which local (mostly rural) populations needed additional income or lacked more profitable opportunities for labor. The prices paid to collectors have been low and have not fluctuated greatly. At present, this activity has practically come to a halt.

Only small financial returns, at best, can be expected from sumac. Therefore, collecting the leaf material from native stands for market cannot pay well enough to be worth while in any locality where sumac is not abundant and easily accessible, and the only possible place of sumac as a farm crop is on hillside areas of the poorer soils, in the regions where it grows naturally. On such areas, its growth habit and some of the cultural methods used in growing it would serve to control soil erosion and it might bring in a little profit. Much of the work involved in growing it could be done by youthful members of a farm family. The extent to which the necessary work could be done by the farm family, without cash outlay, at a time when some of the labor available on the farm could not be used profitably otherwise, would tend to determine whether growing sumac as a farm crop is justifiable. Results of the study of propagation and management are presented here with the warning that the farmer should not consider growing sumac unless under especially favorable conditions as to market and labor supply.

CHARACTERISTICS AND RANGE OF SPECIES

Each of the three native sumac species that have been used for tannin production is a shrub or small tree. Each bears its fruit in clusters at the ends of branches.

Dwarf sumac (*Rhus copallina* L.) has dark-green leaflets that are smooth on top, paler and often hairy underneath, with smooth edges (fig. 1). The fruit is reddish and somewhat hairy. This species is easily distinguished from the two others by the fact that the leaf stem has "wings" growing between the leaflets.

White sumac (*Rhus glabra* L.) has leaflets with sharply saw-toothed edges, dark green on top and whitish underneath (fig. 2). The fruit is covered with short crimson hairs. Characteristics distinguishing this species from the two others are the smoothness of its stalks and the bluish-white bloom that covers the stalks and the under sides of the leaflets.

Staghorn sumac (*Rhus typhina* Torn.) has leaves with sharply saw-toothed edges, dark green and nearly smooth on top but pale and more or less hairy underneath (fig. 3). The fruit has a thick covering of bright crimson hairs. The distinguishing characteristic is a hairy growth along the stalks and leaf stems. This species grows taller than the others, sometimes reaching a height of 40 feet.

Leaf-stem features that distinguish the three different species are shown in figure 4.

Each of the three species has a wide range (figs. 1, 2, 3, and 5). Each abounds in some sections of the eastern half of the United States. Dwarf sumac is common from Virginia and Kentucky south and southeast to the Gulf coast and the Atlantic coast. White sumac exceeds the others in abundance in a belt reaching from southern Ohio through Iowa and Missouri. Staghorn sumac occurs commonly in the North and in the southern Appalachian region.

All three species occur on dry sites. The dwarf and white sumac grow commonly along roadsides, at the edges of woods, and in fence rows and

FIGURE 1.—Typical foliage of dwarf sumac (*Rhus copallina* L.): 1, Stem; 2, petiole; 3, rachis (winged); 4, lateral leaflet; 5, terminal leaflet. (The map indicates the principal range of this species.)

open uncultivated hillside fields. Staghorn sumac more frequently occurs as dense growth on rocky hillsides.

The tannin content of leaf material of the three species of sumac discussed here varies considerably both among and within species. According to analyses of many leaf samples collected over wide areas in which these species are most abundant, the highest regional average tannin content for any of the species is 36.6 percent, found in the leaves of dwarf

FIGURE 2.—Typical foliage of white sumac (*Rhus glabra* L.). (The map indicates the principal range of this species.)

sumac in the Gulf coast region; the next highest, 33 percent, in the same species growing in the southern Appalachian region (fig. 5). In Florida and other parts of the southeastern coastal region the average for dwarf sumac is only 27 percent. Almost identical with this is the average for white sumac throughout its eastern range and in Iowa. The lowest average tannin percentage, 25.6, is found in staghorn sumac. All these percentages pertain to clean, hand-picked leaves with a minimum of woody stems. They exceed the usual tannin content of sumac collected for market by the methods commonly used in localities where wild sumac has been collected and marketed for years.

FIGURE 3.—Typical foliage of staghorn sumac (*Rhus typhina* Torn.). (The map indicates the principal range of this species.)

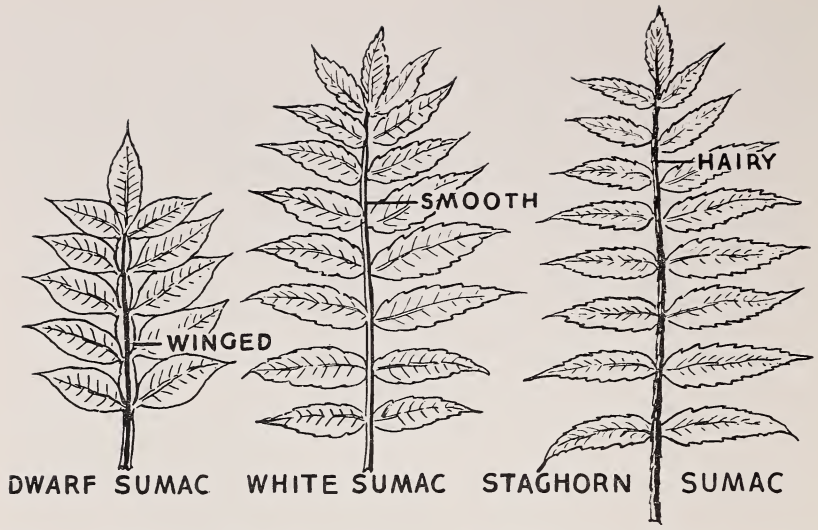

FIGURE 4.—Leaf-stem characteristics of the three native sumac species collected for tannin production.

UTILIZATION OF WILD SUMAC

Dwarf sumac has rated highest of the native sumac species with buyers, probably because it contains the largest proportion of tannin. White sumac and staghorn sumac have usually been marketed in small quantities in mixture with the dwarf. The usefulness of each of the several species depends not solely on the percentage of tannin in its leaf material but in part on how its tannin affects leather and on the particular type of leather desired.

Usually the leaves, leaf stems, and new stalk growth are collected by breaking the stalk immediately below the lowest leaf stem, by hand (fig. 6). The leaflets and leaf stems contain more tannin and are more valuable than any other part; the woody stems have practically no value. In dense, pure sprout stands it may be advantageous to mow the sumac with a scythe or a mowing machine. The amount of usable sumac that one person can gather in a day varies greatly with the character of the leafage and with the care he takes. Under fairly favorable conditions one man should collect in a day enough to make 100 to 300 pounds of dry material.

The quality of sumac material prepared for market has varied widely according to the care exercised in collecting and drying it. Two conditions largely determine the value of the product: The proportion of woody stems, and the moisture content. Sumac should be collected only on dry days, because exposure to rain or dew impairs its quality. If the cut material is not spread out sufficiently to prevent heating while it dries, the leaves darken. This lowers the quality of the milled sumac and makes the tannin extracted from it greatly inferior to that extracted from the imported Sicilian product.

A satisfactory product can usually be obtained by following a few simple instructions. The best season for collecting sumac extends from about July 1 to the time when the leaves begin to change color; later, the tannin content declines. Only material of the current year's growth should be

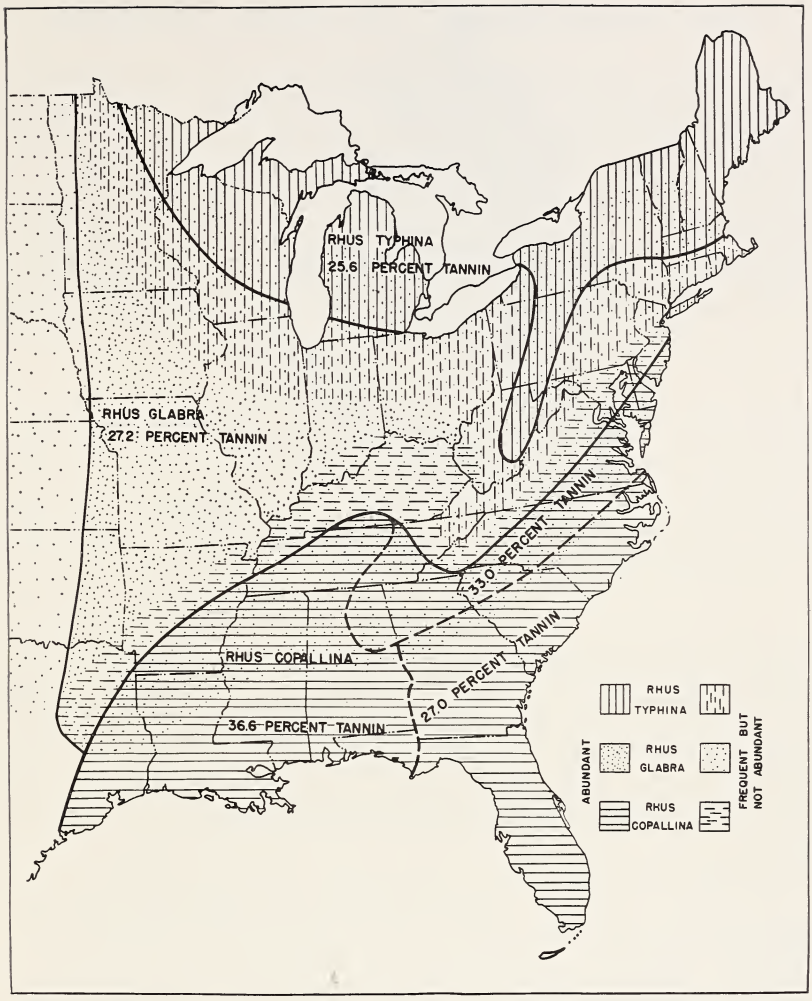

FIGURE 5.—Distribution, relative abundance, and average tannin content of each of the three native sumac species collected for tannin production.

collected. The collected material may be left in the sun to wilt for a few hours, but before the end of the day it should be hauled to a barn or shed and spread out in the shade, either in a layer 1 to 3 feet deep on the floor or on a wire-bottomed rack through which air can circulate. (Use of such a rack is described later, on p. 12.) The material should be turned once or twice a day for a week, to loosen it, prevent heating, and keep it from molding or turning black. After proper drying, sumac leaves have a bright green color.

When completely dry, the collected sumac is usually delivered to a local buyer in bags or loose in wagonloads, like hay. The buyer bales the fully dried sumac and ships it to a manufacturer of tannin extract, or to a tanner for use in powdered form.

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Figure 6.—The usual method of collecting sumac.

The sumac delivered to buyers by collectors varies greatly in respect to tannin content, leafiness, and color, according to the condition of the growing plants, the prevailing weather, and the general care exercised by the collector. Its quality would probably average higher if the prices paid by buyers were based on quality to a greater extent than they generally seem to be now. Small lots of inferior quality are frequently taken by buyers at the prevailing market price; hence there is not much incentive to exercise care in harvesting and curing the sumac.

Machine harvesting of sumac leaf material from native stands has been tested at the Iowa Agricultural Experiment Station.[1] A specially designed tractor-powered harvester proved practical for harvesting white sumac in fairly dense stands free of other large vegetation. Drying the material thus harvested in a shed with forced circulation of unheated air was tested, also. The air was blown through openings in a shed floor 64 feet long and 20 feet wide loaded with the material to a depth of 8 feet. Operating the blower, on an average, 6 hours per day for 7 days reduced the moisture content of the sumac from 55 percent to about 12 percent.

[1] Barger, E. L., and Aikman, J. M. mechanization of sumac leaf harvesting and processing. Agr. Engin. 26: 243–245, illus. 1945. (Jour. Paper J1287, Iowa Agr. Expt. Sta. Proj. 865.)

GROWING SUMAC AS A COMMERCIAL CROP

The Agricultural Research Service investigation of sumac as a farm crop included studies on propagation, cultivation, harvesting, drying, preparation for market, yields, and production costs. Several methods of propagation were tested in numerous preliminary small plantings. A 3-acre field planting was then made at the Agricultural Research Center, at Beltsville, Md., on contours on a hillside area of poor soil subject to abnormal erosion, the only type of farmland likely to be considered for growing crops of sumac. The seedlings planted had been grown from seed collected mainly in the part of Virginia where wild sumac has been collected and sold for tannin production for many years. The resulting stand was managed for 4 years by methods believed to be practical on such land.

PROPAGATION

Numerous trials indicated that planting root cuttings of sumac establishes the crop in less time than planting seed, but that it frequently fails to result in good stands and therefore cannot generally be recommended. Direct seeding in the field is undependable except under very favorable conditions. The best results were obtained by propagating seedlings in a well-prepared seedbed and transplanting them to the field after 1 year. This method was used in establishing the 3-acre planting at Beltsville.

Propagation From Root Cuttings

Root cuttings for planting are obtained by digging the roots of mature plants. Enough roots for a small planting can efficiently be pulled by hand if the soil is loose. For a large supply, the roots of a dense stand are plowed out with a turning plow and collected by hand or with a pitchfork. The collected roots are covered with soil or wet burlap to prevent drying. Those from one-fourth to three-fourths inch in diameter are cut into sections 8 to 10 inches long, which are then tied in bundles of about 50 pieces each. Roots below or above this diameter range are discarded. The best plan is to prepare the root cuttings in very early spring, when the plants are still dormant, and cover them with a layer of soil that will prevent them from drying while they await planting.

The planting area is prepared as for most other field crops. If it is hilly or sloping, the rows are laid out on the contour to control soil erosion. Rows are spaced 4 feet apart, and furrows are opened to a depth of about 4 inches. Planting is done at about the time when the growing season begins. The cuttings are dropped lengthwise in the row 3 or 4 inches apart. When the furrow has been closed, the soil is firmed by tramping.

Propagation from root cuttings is not considered practical for plantings of an acre or more. The shoots emerge slowly and irregularly, and frequently they fail to form a satisfactory stand. Prolonged dry weather or crusting of the soil after planting reduces the stand considerably. The shoots grow slowly at first, and control of weeds or grass may require considerable hand labor until the plants have grown to a size that permits cultivation.

Propagation From Seed

Seed may be collected soon after the first frost in the fall of the year. The pulpy covering that encloses the seed is removed by rubbing the seed through a screen. Many of the seeds are sterile. In order to remove these, each cleaned lot is placed in water, in which the viable seeds sink but the

sterile ones float. Because the seed has a very hard coat, it must be treated with concentrated sulfuric acid to ensure satisfactory germination.

A lot of 1 or 2 pounds is poured slowly into the acid in an earthenware or pyrex vessel with constant stirring with a glass rod or wooden paddle, and the stirring is continued intermittently for 2 hours. The mixture is next poured first onto a copper screen, to drain off the excess acid, and then into a large quantity of water, with thorough stirring. Thorough washing of seed in several changes of water is necessary to remove all the acid. Lime or soda may be added to the final washings to assure complete neutralization of the acid. The washed seed is spread in a thin layer on a clean surface to dry.

For treating larger quantities of seed the same general procedure may be followed. Up to 10 pounds of seed can be treated in a 10-gallon earthenware crock. A wooden paddle is used for stirring the mixture. In treating such quantities it has been found advantageous to drain off the acid after an hour and treat the seed for another hour with fresh acid.

Sulfuric acid is extremely corrosive. The greatest care must be used in handling it.

Direct sowing in the field, when tried on a 2-acre tract in central Virginia, failed completely. The land had been weedy and grassy for a year or more. Emergence was satisfactory, and a good stand of the sumac was obtained, but the small seedlings were smothered by rapidly growing weeds and, especially, by annual grasses. Apparently direct field sowing cannot succeed unless, perhaps, on ground that has been maintained in clean culture for several years.

Sowing acid-treated seed in a well-prepared seedbed treated for weed control will assure, with very little handwork, a good supply of seedlings for field planting the following year. The seedbed should be located on a well-drained site with fairly deep topsoil. Preferably the bed is made not more than 4 feet wide, to permit weeding from the edges. It is prepared in the fall, for seeding the following spring, by plowing and disking the soil to a depth of 5 to 6 inches or by working with a rotary tiller. Unless the soil is known to be weed free it is advisable to apply calcium cyanamide, an effective weed-control chemical, at this time. The chemical is applied broadcast to the leveled bed at the rate of two-thirds pound per square yard and is thoroughly worked into the top 3 or 4 inches of soil. After the bed is again leveled, an additional one-third pound per square yard is broadcast on the soil and lightly raked in. The surface of the treated bed is not disturbed until planting time, and then a light raking will suffice. Drainage ditches around the bed are provided to prevent surface water from washing onto the treated soil.

The acid-treated seed is sown broadcast in the spring when the danger of frost has passed and the soil has become fairly warm. It is raked in very lightly. One pound of seed will plant approximately 100 square feet, or a bed 4 feet wide and 25 feet long, and should produce 1,200 to 1,500 seedlings suitable for transplanting. If the soil is not free of weed and grass seed and the seedbed is not treated for weed control, hand weeding will be necessary, and this will be made easier by planting the seed in rows spaced 2 or 3 inches apart.

The seedlings are lifted when dormant, at the end of the growing season. The soil beneath them is loosened with a spade or fork, and they are pulled by hand. They are then gathered in a convenient working area for sorting and bundling and are covered with wet burlap or soil as a protection against drying. The seedlings, which may range from 6 to 18

inches in height, are graded into 3 sizes for convenience in planting. They are then made up in bundles of about 50 and securely tied. Any long or spreading roots are trimmed back with a sharp hatchet. (The tops are not trimmed.) The bundled seedlings are then heeled in, by placing the bundles upright in a narrow trench, covering the roots with soil to the soil line, and firming the soil by tramping.

Seedlings grown in a seedbed are set in the field during late winter or early spring, before they start their second year's growth. The soil is prepared as for any row crop. On sloping land, rows are laid out on the contour according to the best soil-conservation practices. The rows are spaced 4 feet apart, and furrows are opened to a depth of 4 inches. The seedlings are placed about 18 inches apart in the row. The planter holds a seedling upright with its roots in the bottom of the furrow, draws the soil in from both sides with his feet, and firmly presses the soil around the roots. When only a small planting is made, the seedlings may be set in holes dug with a spade or hoe.

CULTIVATION

The first year, the field planting is handled as a cultivated row crop. If the area used for planting had previously remained uncultivated for some time, many weeds and grasses will doubtless appear and frequent cultivation between the rows and hoeing or hand weeding within the rows will be necessary to permit the seedlings to become well established. After the first year such cultivation is impossible, on account of the shallow, spreading root growth of the plants. The larger weeds within the rows may be removed by hand, and a power mower, with the sickle bar mounted in front, may be used to control weed growth between rows. Plants thus cultivated can maintain approximately normal growth.

HARVESTING

The first harvest of leaf material is made during the second season's growth in the field, at the time when quantity of foliage and percentage of tannin in the foliage are both at their greatest. In most locations this is the period from about July 1 to the time when the leaves begin to change color. Only one crop is obtained each year, although the plants usually make considerable new growth between harvest and the time when they become dormant.

The method of harvesting to be used depends on the size and condition of the planting and the facilities and equipment available. For small tracts, probably the most practical method is to break the leafy top growth by hand (fig. 6) as the gatherers of wild sumac do. The broken material is either piled on the ground, to be picked up later, or thrown at once into a wagon or truck and hauled to the drying shed.

When large areas are to be harvested, the amount of hand labor required can be materially reduced by use of machinery commonly available on farms. An ordinary hay mower has proved very satisfactory for cutting year-old growth. If the soil is free of trash and weeds, plants cut with a mower may be raked into piles with a dump rake; otherwise, it is necessary to gather the cut plants by hand or with a pitchfork. Weeds gathered with the plants should be removed at once, for they cannot readily be separated once the material has dried. In using a mower for harvesting the second and subsequent crops the cut must be made above the stumps left when the plants were cut previously.

Special harvesting machinery such as was used on extensive natural stands of white sumac in the investigations in Iowa [2] has not been used for harvesting the cultivated crop. However, in the report on those investigations it is pointed out that a much lighter machine could well be designed and used for harvesting row plantings on contours on sloping ground. Anyone undertaking to grow a considerable acreage of sumac should seriously consider providing himself with such labor-saving equipment, in view of the low market value of the crop.

To assure the highest quality of product, only the leaves and leaf stems should be harvested. When the harvesting is done by hand undesirable reddened leaves, excessively woody stems, and the fruiting heads may be largely avoided. When machines are used, these portions must be removed from the harvested material by hand to assure that the product will have maximum tannin content and other desired qualities. Only heavy stems can be removed after the material has dried. The harvested material must have complete protection from dew or rain.

DRYING

To produce high-grade sumac, the harvested leaf material must be properly dried. It usually contains about 60 percent moisture. This can be reduced considerably by allowing the material to lie exposed to sunshine either in the swath, in windrows, or in small piles. Although the material must not be exposed to rain or dew, during periods of very dry weather it may be left in the field several days to advantage. The wilted or partially dried material is then brought indoors. If a well-ventilated building with a wooden floor is available the material may be spread thinly on a section of the floor and left there several days, with occasional stirring. It is then moved aside to form a pile several feet deep for further drying, while another portion is spread out on the floor, later to be piled on top of the first. This may be repeated several times, so a considerable quantity of material can be handled in a relatively small space.

Another method is to spread the leaf material on a wire-bottomed rack, constructed with 1- or 2-inch poultry mesh, in a barn or otherwise under roof. The rack should be so placed that as the dry leaves shatter and drop through it they will fall onto a clean floor several feet below. The green or partially wilted material is spread on the wire to a depth of about 6 inches if it consists mainly of leaves, to a greater depth if it consists mainly of branched stalks. In good drying weather and with daily stirring the material will have dried sufficiently after a few days to permit spreading another layer over it. This may be repeated several times.

The time required to dry the leaf material completely by either method depends on the prevailing weather and the proportion of material other than leafage present. The leaves and small stems can be dried rapidly under favorable conditions, but large stalks and fruiting heads require considerably more time.

The drying operation can be carried out more rapidly by using a blower as described on page 8. Use of heated air, with or without a blower, has possibilities. A blower or hot air must undoubtedly be used if the material from any considerable acreage is to be dried.

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[2] See footnote 1, p. 8.

PREPARATION FOR MARKET

Sumac leaf material cut with a mower usually contains an undesirable proportion of large stems. If the material has been dried on a wire rack, the leaves and small stems can be worked through the wire mesh by trampling and forking and the larger stems remaining on the wire discarded. If it has been dried on a floor, flailing or trampling will separate the leaves, after which the large stems can be removed with a fork or picked out by hand. These methods are tedious and are impractical for handling large lots of material. Moreover, they break up the leaves too much to permit baling.

For stripping and cleaning the dry sumac on a large scale, a modified grain thresher was tested in the Iowa investigations. Cylinder speed and air blast were adjusted, and the teeth were removed from the concaves. The thresher satisfactorily separated the leaves. The adjustments needed would have to be determined to some extent, in each case, by actual trial, according to the condition of the material to be handled.

YIELDS

The yields and quality of sumac leaf obtainable under cultivation depend on the soil, on the weather, and, apparently, to a large degree on the age of the planting. Because no reports on other acreage plantings are available, estimates of yields of dwarf sumac leaf are here based on the results obtained from the planting at Beltsville, Md. The first harvest, which was from the second season's growth on 2.6 acres, yielded 825 pounds of dried leaf per acre. This included a low percentage of small stems, probably less than that usually present in the marketed product obtained from wild plants. The second harvest, from 2.2 acres, yielded 458 pounds per acre; the third, from a similar acreage, 207 pounds. Thus a total of 1,490 pounds of marketable crop per acre was obtained in 3 annual harvests and in 4 years of land use.

On the whole, the tannin content of the properly prepared material obtained from this planting was satisfactory. It was probably higher than the average for the product usually obtained in this country from wild plants.

The investigations here reported have furnished considerable evidence that certain strains of dwarf sumac definitely excel others in tannin content and that they continue to do so year after year under cultivation. This suggests that the quality of the cultivated crop could be improved by selection and that the improved quality could be consistently maintained. The relations of tannin content to general growth vigor, leafiness, and leaf yield have not been established.

The rapid decline in yields of the Beltsville planting clearly indicates that, after fairly satisfactory growth during the first year in the field and the first harvest year, one or more factors operated to reduce greatly the general vigor of the plants. Not many plants died, but leaf production of individual plants greatly diminished. The relatively poor soil of the tract does not explain the decline in yield, since this soil sustained satisfactory growth the first 2 years. It seems likely that annual cutting of the current growth depleted the plants' vigor. Because the crop is harvested in midsummer, during the period of lush growth, the plants do not attain normal root development and therefore do not grow so well the next season. They make some new growth between harvest and the beginning of dormancy, but this probably does not add significantly to their store of food reserves.

To maintain plant vigor it may be necessary to omit harvesting leaf material in alternate years. In addition to eliminating some harvesting costs this might increase total yield over a period of several years.

PRODUCTION COSTS

The cost of growing sumac as a cultivated crop would vary widely according to the cost of labor, and the availability of family labor for the purpose, on the individual farm. Estimates of the man-hours and tractor-hours required for the several operations involved in establishing, maintaining, and harvesting an acre of sumac and preparing the product for market are presented in table 1.

TABLE 1.—*Estimated production requirements of 1 acre of cultivated sumac*

Operation	Man-hours				Tractor-hours			
	1st year	2d year	3d year	Each subsequent year	1st year	2d year	3d year	Each subsequent year
Seedling production	52				2			
Planting		30				7.5		
Cultivation		60	16	8		8	8	6
Cutting			2	2			2	2
Drying			2.5	2				
Bagging			4	3				
Total	52	90	24.5	15	2	15.5	10	8

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